Joint Modeling and Simulation System (JMASS)

JOINT INITIAL REQUIREMENTS DOCUMENT (JIRD)

28 February 1997

Send any comments or recommendations to:
OUSD(A&T)/DTSE&E/TFR
Attn: Mr. Dennis O. Hines
Pentagon, Room 3D1067
Washington, DC 20301
E-Mail: hinesdo@acq.osd.mil

14 November 1997

7 APRIL 1997

MEMORANDUM FOR JOINT MODELING AND SIMULATION SYSTEM (JMASS)
SENIOR STEERING GROUP (SSG) MEMBERS

SUBJECT: Joint Initial Requirements Document (JIRD)

Attached is the result of over a year's worth of effort on the part of your representatives on the JMASS Implementation Team to develop a baseline requirements document for a Modeling and Simulation (M&S) system that supports the acquisition process. The JIRD represents the Team's best understanding of the initial overall programmatic requirements, high level capabilities, and operational and support requirements for JMASS at this point in time and their effort is to be applauded.

It is also understood that these are "initial" requirements which need to be evolved and tested through Pilot Projects which have been designated by the Steering Group. This process will lead to a more fully defined set of requirements that will be documented in a Joint Requirements Document which will be

- Fully coordinated throughout the acquisition community,
- Presented to the EXCIMS for approval, and
- Implemented by a Joint Program Office or similar management structure to oversee the development of the required system including a potential commercial-off-the shelf procurement.

The signatures appearing in the JIRD represent a commitment on the part of the Senior Steering Group members to work together during the next year to achieve this objective.

SIGNED

Patricia Sanders
Director, Test, Systems
Engineering and Evaluation

SIGNATURE PAGE

By our signatures, the undersigned agree that this Joint Initial Requirements Document (JIRD) identifies the initial functional requirements for a Joint Modeling and Simulation System (JMASS).

SIGNED

SARDA-ZD

SIGNED

OPNAV N091

SIGNED

AF/TE

SIGNED

DI-CS

SIGNED 2/28/97

OUSD(A&T)/DTSE&E

Joint Modeling and Simulation System (JMASS)
Joint Initial Requirements Document (JIRD)

Table of Contents

Joint Modeling and Simulation System (JMASS)
Joint Initial Requirements Document (JIRD)

Background

The Joint Modeling and Simulation System (JMASS) requirements will evolve through multiple stages. The purpose of this document is to define the initial overall programmatic requirements, high level capabilities, operation and support requirements for JMASS. Pilot Projects will be used to refine and further specify the requirements in this document. Implementation of the specific requirements will be accomplished by a Program Office.

1. General Description of Operational Capability

JMASS is designed to support acquisition as defined in the Department of Defense (DoD) Regulation 5000.2-R.[1] JMASS provides a software architecture for the development of models, configuration of models into simulations, execution of simulations, and post processing of data obtained from the simulation. The JMASS software facilitates interoperability with other simulations in accordance with DoD accepted standards. Additionally, it defines and implements a set of standards and documentation for JMASS compliant models. It provides tools that assist in the development and application of reusable models and model components. Standards defined and implemented by JMASS shall include:

- Guidelines for the development of JMASS compliant models and documentation. These guidelines are called the Software Structural Model (SSM)[2,3]
- Tools to implement the SSM
- Model-to-model and model-to-system interfaces
- Tool-to-system interfaces
- Guidelines and tools for porting legacy models to JMASS
- Man-machine interface modeling

The Joint Simulation System (JSIMS) and Joint Warfare System (JWARS) will build models and simulations and foster interoperability and reuse of models from the mission/battle through campaign/threat level. JMASS will help build models and simulations and foster interoperability and reuse of models from the subsystem/component through the engagement/system level (Figure 1). The High Level Architecture (HLA)[4] is chartered to foster interoperability and reuse of simulations across the modeling and simulation (M&S) spectrum (i.e., subsystem, system, mission, theater).

In addition, JMASS provides a Modeling and Simulation Reuse Library of JMASS compliant models as well as related documentation and data.

2. Threat. Not applicable.

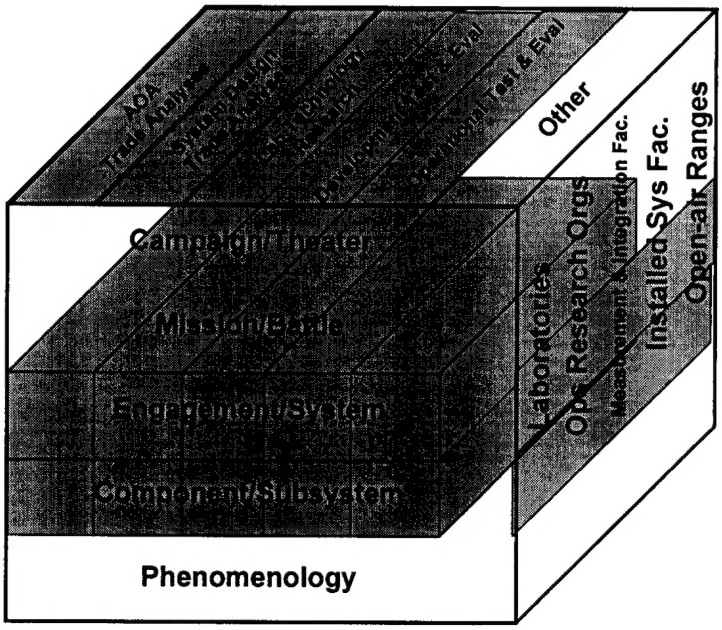

Figure 1. Assessment of Current Demand for JMASS

3. Shortcomings of Existing Systems

There is no current process within the DoD which provides affordable tools to conduct requisite performance and engineering analysis in a timely manner for the purpose of determining performance requirements analysis, system functional analysis, and implementation detail cost tradeoff analysis within a total force context and throughout the life cycle of a program. Current DoD and Service modeling and simulation approaches have been independently developed and maintained around specific warfare areas and platforms which precludes transfer of information or integration of results in an aggregate force level analysis. This results in a very costly and time consuming process of patching models to models and simulations to simulations which do not reflect the actual behavior of defense systems. Current models cannot account for full spectrum environmental effects on sensor performance which dominate complex weapon system performance.

Every DoD activity and Service activity has been required to independently develop the entire software communications infrastructure layer to allow their program specific questions to be adequately addressed. This has resulted in independent approaches to:

- the run time environment for the execution of models and simulations
- the interfaces between model to model and from acquisition phase to acquisition phase with little reuse possible

- database design and accessibility
- tools to build application specific models and simulations
- the definition of operational and physical world frames of reference

Due to the absence of standards there are many duplicative model development efforts, particularly in the area of threat systems and environmental representation.

4. Capabilities Required

A. Required JMASS Functional Capabilities

These required JMASS functional capabilities will provide a model development and simulation system to support JMASS users in the development and maintenance of object-oriented models and simulations, configuration of different scenarios, setup and execution of simulation, and analysis of results.

JMASS shall:

(1) Provide tools to support computer aided development and maintenance of object-oriented models of systems and environments for use in the following activities:

- operations analysis
- concept formulation
- engineering discipline specific analysis
- total ownership cost analysis
- design and construction analysis
- test planning and performance prediction analysis
- maintenance and operations analysis
- manufacturing and process flow analysis

(a) Establish standards for developing JMASS compliant models and associated documentation.

(b) Support computer aided development and maintenance of component/subsystem and engagement/system level models of complex systems.

(c) Permit the capability to operate and interoperate at both the engagement/system and component/subsystem levels.

(d) Provide guidelines and tools for porting legacy models to JMASS.

(e) Support computer aided development and maintenance of environmental models which are representative of the actual operational and physical environment that a system under investigation is expected to operate in. JMASS must allow models that address the full spectrum of the physical environment. Specifically, the bathymetry, hydrography, sea-air interface, terrain, meteorology, atmosphere, and exoatmosphere must be able to be represented.

(f) Provide the ability to use commercial-off-the-shelf (COTS) and existing government tools to develop models and to process data.

(g) Provide ability to selectively execute language specific and operating system software debugging tools including software traps, stepped execution, tracing, and output during runtime without perturbing other models, players, or general simulation execution.

(2) Provide tools to configure system and environment models and appropriate data to create synchronized simulations of operational scenarios. This synchronization shall provide:

(a) Tools to assist users in entering parametric data, to include initial conditions, defaults values for reusable components, scenario definition via tabular and graphical means, visual placement of objects in the simulation, and all necessary steps required to begin a simulation.

(b) An efficient and flexible simulation time/event synchronization function that supports faster than real-time digital simulations; real-time simulations, including operator-in-the-loop, hardware-in-the-loop, tactical systems, and live assets; and slower than real-time simulations. Provide capability to accept online, real-time inputs to dynamically alter controllable variables. Provide the data from simulations as on-line, real-time outputs to system(s) under test.

(3) Provide tools to execute simulations and gather performance data for the purpose of analysis and visualization of the results.

(a) Implement the following simulation control functions: start, pause, restart, terminate, and vary the time standard. Provide the capability to access the current simulation state during a pause.

(b) Provide accurate data time tagging and a repeatable, controlled time/event synchronization with precise linear relationships between the system clock, model execution and data transfers.

(c) The inclusion of objects and models into a simulation and the removal of objects and models from a simulation shall be capable of being accomplished dynamically, on-line during the simulation execution as well as off line. Whether performed on-line or off line, the inclusion or removal of objects and models shall be automatically accommodated by the operating system and structure of JMASS and shall not require any manual software modification or recompiles.

(d) Provide the user the capability to monitor the simulation and individual model behavior during simulation runtime.

(4) Provide tools or interfaces to legacy tools to support computer aided data visualization, data analysis and evaluation of simulation results for the following purposes:

- operations analysis
- concept formulation
- engineering discipline specific analysis
- total ownership cost analysis
- design and construction analysis
- test planning and performance prediction analysis
- maintenance and operations analysis
- manufacturing and process flow analysis

(a) Desired end products include engineering graphs, tables, maps, traces of actual versus predicted value, position, animation, etc. Interface standards and object model templates will be specified for tool sets.

(b) Provide the ability to use COTS and existing government tools to develop models and to process data.

(5) Provide a non-proprietary evolutionary support infrastructure which will insure flexibility, openness and minimal constraints to users. This infrastructure shall be designed to isolate the impact of changes to the system. Required capabilities are grouped into three areas: (a) underlying technologies associated with high performance computing, processing, displays, and peripherals; (b) primitive support services linking users to the hardware run time environment; and (c) operational support services which isolate the user from the mundane system alignment tasks thereby freeing him or her to concentrate on the tasks of building, executing, and analyzing complex simulations.

(a) Underlying technologies

(i) JMASS shall be capable of being hosted on high end personal computers, workstations and high performance computers.

(ii) Provide a capability to support rapid exchange of high volumes of information, and support servicing of priority data transfers between locally distributed systems.

(b) Primitive support services

(i) The development tools and the supporting JMASS software will be unclassified. JMASS shall include a security package such that all models and data are appropriately marked.

(ii) Notify operator of exception conditions and faults asserted during a simulation (e.g., hardware malfunction). Support domain specific/user defined exception handlers to service exception conditions and hardware faults asserted during a run.

(iii) Provide tools to support defining and establishing interfaces among models within a simulation and between the system infrastructure and the models. Support message and data passing over distributed heterogeneous networks with minimal latency. Have interface standards that enable insertion of new technologies. These standards shall use or provide compatibility with industry or DoD standards for communications between model objects. Perform all necessary data conditioning to make the data movement and storage transparent to the object models.

(iv) Coordinate and synchronize data traffic between objects and support objects with different update rates. JMASS will permit variability of synchronization tolerances or different data rates.

(v) As part of the JMASS installation procedures, JMASS shall sense network parameters which are critical to successful installation. Incompatibilities shall be flagged and presented to the installer.

(vi) Confirm, prior to simulation start, that all software and hardware is ready to begin simulation.

(vii) The human computer interface shall include graphic interfaces.

(viii) JMASS shall provide tools for data management.

(c) Operational support services

(i) Support use of COTS tools to assist in software configuration management of models.

(ii) Provide the ability to configure, execute, and analyze the results of statistical simulations.

(iii) Provide the capability to wrap legacy models.

(iv) Support multimedia publication services for the purpose of demonstration and report generation.

(v) Provide an evolution of the system to insure that objects built to prior releases remain viable and are compatible with existing releases. When capability can not be maintained, conversion tools shall be provided.

(6) Provide computer aided verification and validation methods and tools for new models and simulations developed within the JMASS.

(7) Provide a Modeling and Simulation Reuse library of JMASS compliant models as well as related documentation and data.

(a) Provide an interface with the DoD Modeling and Simulation Resource Repository.

(b) Support COTS tools to assist in library management.

(8) Provide on-line computer assisted help routines as well as on-line user documentation to facilitate training and operator assistance.

B. Logistics and Readiness. Not applicable.

C. Other System Characteristics. Not applicable.

5. Program Support

A. Software and Documentation Maintenance

This system shall be used in many geographically dispersed sites and shall require a central support activity to provide publishing, distribution and maintenance services and support. Maintenance will address only those portions of JMASS that have been developed by the JMASS Program or provided to users of JMASS by the JMASS Program Office. These items include off-line development; configuration, and post processing tools; on-line data logging and analysis tools; and simulation control.

B. Support Equipment and Software

No special support equipment nor software shall be required.

C. Human Systems Integration

(1) Provide a user-friendly Human Computer Interface.

(2) Tutorials, on-line references, manuals, and context sensitive help screens, to include all system configuration, operations and maintenance, shall be available to assist operators for those tasks which are not easily handled intuitively.

(3) Develop and maintain on-line as continuously available soft copy, a users manual and complete set of all documentation.

D. Computer Resources

(1) Open Systems Architecture and Standards

JMASS shall have an open systems architecture using industry or DoD standards. It shall operate on and be portable between workstations.

(2) Hardware

(a) JMASS software shall be transportable and shall be capable of being hosted on high end personal computers, workstations, and high performance computers.

(b) Support multiprocessor operations for a single team or a single player.

(3) Software

(a) Software shall be developed and maintained according to the practices delineated by the Software Engineering Institute.[2,3]

(b) Software shall be tested in accordance with DoD 5000.2-R

E. Other Logistics Considerations. Not applicable.

F. Command, Control, Communications, Computers and Intelligence. Not applicable.

G. Transportation and Basing. Not applicable.

H. Standardization, Interoperability, and Commonality

JMASS shall be fully compliant with appropriate versions of Distributed Interactive Simulation (DIS) and HLA.

I. Mapping, Charting, and Geodesy Support. Not applicable.

J. Environmental Support. Not applicable.

6. Force Structure. Not applicable.

7. Schedule Considerations

To be determined. Services to provide initial operational capability and final operational capability criteria based on pilot projects.

ABBREVIATIONS

AOA	Analysis of Alternatives
COTS	Commercial-off-the-shelf
DoD	Department of Defense
DIS	Distributed Interactive Simulation
HLA	High Level Architecture
JIRD	Joint Initial Requirements Document
JMASS	Joint Modeling and Simulation System
JSIMS	Joint Simulation System
JWARS	Joint Warfare System
M&S	Modeling and simulation
SSM	Software Structural Model

GLOSSARY

Cell A cell is a set of simulation entities using fully consistent databases and simulations, i.e., the simulation models have been specifically designed to work together. All entities within a cell must have unrestricted broadcast of datagram messages to all other entities within the cell. By definition, the entities in a cell are homogeneous, and at the same security classification level. For example, a set of interconnected SIMNET simulators using the same terrain database constitute a cell. A cell is usually located on a single local network, but it is possible to distribute one over a wide area network if sufficient bandwidth is available and latency is low enough to maintain coherency. If any type of interface is required to network with a remote site, the two sites are different cells. [DMSO Glossary of M&S Terms]

Component Any model object. A component may have more than one subcomponent.

Fidelity (1) The similarity, both physical and functional, between the simulation and that which it simulates.
(2) A measure of the realism of a simulation.
(3) The degree to which the representation within a simulation is similar to a real world object, feature, or condition in a measurable or perceivable manner. [DMSO Glossary of M&S Terms]

High Performance Computers
Machines with computational capabilities in MIPS or MEGAFLOPS equivalent to a 1990 model Cray.

Open System A system in which the components and their composition are specified in a non-proprietary environment, enabling competing organizations to use these standard components to build competitive systems. There are three perspectives on open systems: portability - the degree to which a system component can be used in various environments, interoperability - the ability of individual components to exchange information, and integration - the consistency of the various human-machine interfaces between an individual and all hardware and software in the system. [DMSO Glossary of M&S Terms]

Player A player is a special type of component; it is the smallest component recognizable during run time as an independent object by the executive.

Proprietary A system where the interfaces do not meet open system standards, i.e. the specifications of the interfaces are exclusively owned by a private individual or corporation under a trademark or patent, the use of which

	would require a license. [Variation based on Proprietary Specification in Open System-JTF TOR, Nov 1995]
Site	(1) An actual physical location at a specific geographic area, e.g., the Ft. Knox Close Combat Test Bed (CCTB) which can contain a single cell, multiple cells, or only part of a cell. (2) A node on the Distributed Interactive Simulation (DIS) long haul network which can contain a single cell, multiple cells, or only part of a cell. (3) A level of configuration authority within a DIS exercise. [DMSO Glossary of M&S Terms]
Team	A grouping of players executed as a single UNIX process.

REFERENCE

1. DoD Regulation 5000.2-R, "Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs", March 15, 1996.

2. "Capability Maturity Model for Software v 1.1", Carnegie-Mellon University/Software Engineering Institute, Report CMU/SEI-93-TR-24.

3. "Key Practices of CMM v 1.1, Carnegie-Mellon University/Software Engineering Institute, Report CMU/SEI-93-TR-25.

4. OUSD(A&T) Memorandum, Subject: DoD High Level Architecture (HLA) for Simulations, dated: Sep 10, 1996, signed by Dr Kaminski.